# STUDY OF VARIOUS PARAMETERS IN DIESEL-GENERATOR SETS

A THESIS SUBMITTED IN PARTIAL FULFILLMENT OF THE REQIUREMENTS

FOR THE DEGREE OF

**Bachelor of Technology**

**In**

**Mechanical Engineering**

**By**

**KOLLI SURYA SREEVATHSANATH**

**109ME0423**


**Department of Mechanical Engineering**
**National Institute of Technology**
**ROURKELA**

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Under the Guidance of

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# CERTIFICATE

This is to certify that the thesis entitled "**STUDY OF VARIOUS PARAMETERS IN DIESEL-GENERATOR SETS**" submitted by **Mr. KOLLI SURYA SREEVATHSANATH (109ME0423)** in partial fulfillment of the requirements for the award of BachelorofTechnologyDegree inMechanical Engineering at National Institute of Technology, Rourkela(Deemed University) isan authentic work carried out by him under my guidance.To the best of my knowledge the matter embodied in the thesis has not been submitted to anyUniversity /Institute for the award of any Degree or Diploma.

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# ABSTRACT

A diesel generator is the combination of a diesel engine with an electric generator (often an alternator) to generate electrical energy. Diesel generating sets are used in places without connection to the powe grid,
as emergency power-supply if the grid fails, as well as for more complex applications such as peak-lopping, grid support and export to the power grid.Setsizes range from 8 to 30 kW (also 8 to 30 kVA single phase) for homes, small shops & offices with the larger industrial generators from 8 kW (11 kVA) up to 2,000 kW (2,500 kVA three phase) used for large office complexes, factories.In addition to this there are factors which diesel generators depend on they are Ambient Temperature , Load on the Generator ,Altitude of operation of the generator.Ambient generator refers to the Inlet temperature .Because the generator works with the diesel engine, the heat that the diesel engine emit make ambient temperature more than 40 celcius. However temperature should be less than 40 celsius for operation. In the present work behaviour of 62.5 KVA Diesel-Generator is studied in ANSYS V13.0 (A licensed Institute software.) First a schematic approximation of the diesel-generator is drawn in the ANSYS Software and then the Experiments are mae to determine the temperature conditions of various surfaces under constant load.These observations are taken for the simulation in the software and the results are displayed.

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## CHAPTER-1

# INTRODUCTION

# INTRODUCTION

## DIESEL-GENERATOR SET:

The packaged combination of a diesel engine, a generator and various ancillary devices (such as base, canopy, sound attenuation, control systems, circuit breakers, jacket water heaters and starting system) is referred to as a "generating set" or a "genset" for short. Generating sets are selected based on the Electrical load they are intended to supply, the electrical loads total characteristics (kWe, kVA, var's and Harmonic Content including starting currents (normally from motors) and non linearloads. The expected duty, for example, emergency, prime or continuous power as well as environmental conditions such as altitude, temperature and emissions regulations must be taken into account.v Generators must provide the anticipated power required reliably and without damage and this is achieved by the manufacturer giving one or more ratings to a specific generator set model. A specific model of a generator operated as a standby generator may only need to operate for a few hours per year, but the same model operated as a prime power generator must operate continuously. When running, the standby generator may be operated with a specified overload that can be

tolerated for the expected short running time. The same model generator will carry a higher rating for standby service than it will for continuous duty. Manufactures give each set a rating based on internationally agreed definitions. Diesel engines should be run at least 60% to 75% of their maximum rated load. Short periods of low load running are permissible providing the set is brought up to full load, or close to full load on a regular basis.In case of fail to run at full load on general basis it would result in the inefficiency of the diesel generator.Running an engine under low loads causes low cylinder pressures and consequent poor piston ring sealing since this relies on the gas pressure to force them against the oil film on the bores to form the seal. Low cylinder pressures causes poor combustion and resultant low combustion pressures and temperatures.

## 1.2

## Generator set specifications

Prime Power Rating kVA / kW 62.5/50

Current (Amps) 87

No. of Phases 3 Phase

Power Factor 0.8 (lag) .

**1.3**

**Engine specifications**:

| | |
|---|---|
| Make | Cummins |
| Model | S 3.8 G7 |
| BHP | 80 |
| Cooling | Water Cooled |
| Aspiration | Turbocharged |
| Charged | Air Cooled |
| No. of Cylinders | 4 |
| RPM | 1500 |
| Bore x Stroke (mm) | 97 x 128 |
| Compression Ratio | 17.5:1 |
| Displacement (Ltrs.) | 3.8 |
| Fuel | HSD |
| Fuel Consumption (Ltr/hr) | 10.8 |
| Governor | Mechanical |
| Starting System | 12 V Electrical |
| Lube oil Specification | CH4 15W40 |
| Lube oil Sump Capacity (Ltrs.) | 9 |
| Lube oil consumption (LPH) | 0.034 |
| Total Coolant Capacity (Ltrs.) | 10.5 |
| ExhaustPipeSize(mm) | 75 |

## CHAPTER-2

# LITERATURE SURVEY

# 2. LITERATURE SURVEY

TiberiuTudorache, Cristian Roman(1) conducted experiments to numerically model the Diesel-generator sets main energy source in isolated areas and as a back-up energy source in the case ofrenewable energy systems.

J.Leuchter, V. Řeřucha, Z. Krupka(2) conducted experiments on dynamic behaviour of Mobile Generator Set with Variable Speed and Diesel EngineThis paper addresses the identification of the dynamic behaviour of such variable-speed EGS systems and the problems encountered during a sudden increase of load.The engine-generator dynamics at a sudden load change (from low load to high load) remains a challenge in case of variable speed diesel generator.

K. R. Hoopingarner(3) reviewed technical specifications foremergency diesel generators in the context of new information developed.

Engine/generator sets, or gensets, represent a sizeable capital investment and often support mission critical processes and facilities for large and mid-sized companies. Their failure to perform properly when started up suddenly is almost always accompanied by actual or potentially dangerous conditions

# CHAPTER 3

# MATERIALS AND METHODS

## 3. MATERIALS AND METHODS

The generator with 62.5KVA load is taken for the data and the specifications for the generator are as follows:

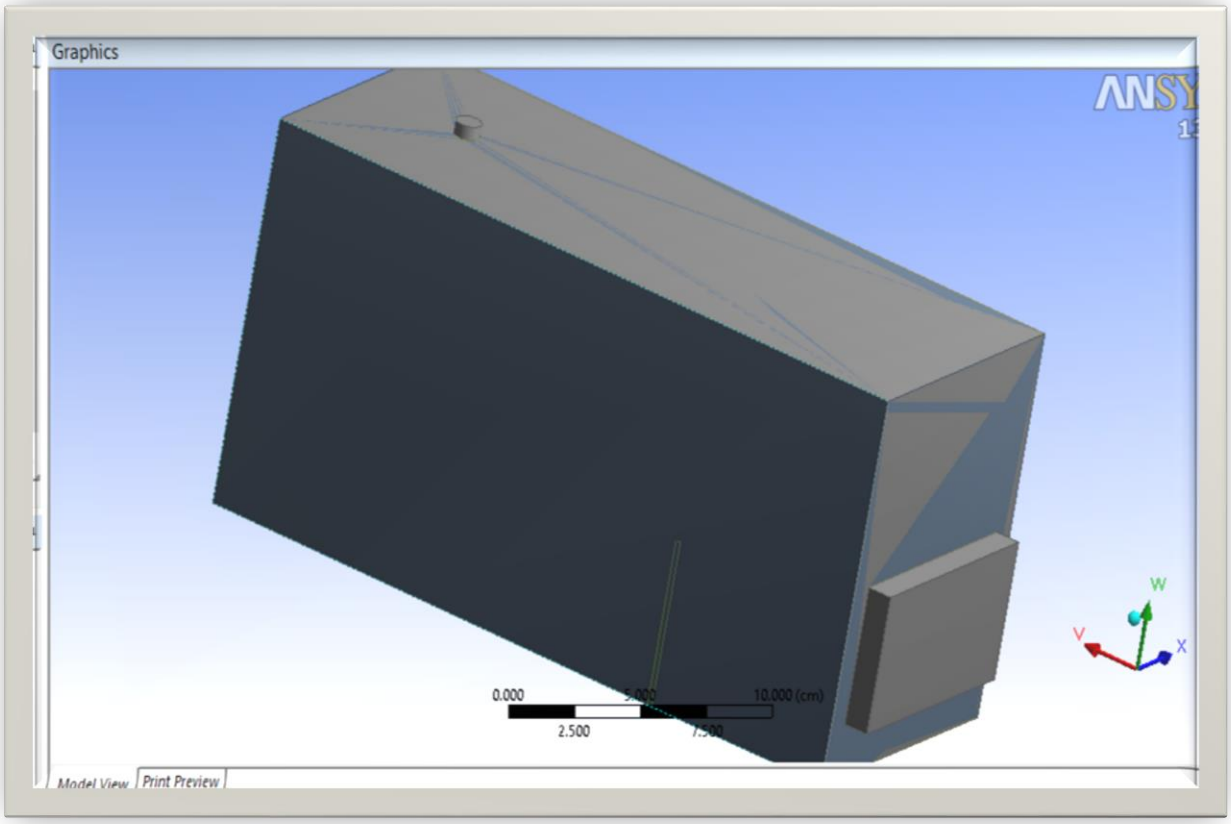
Dimensions for the generator-set(cm):

| | |
|---|---|
| Dimensions for the entire casing: | 280X140X110 |
| Approximated dimensions of the engine | 80X45X40 |
| Power Box | 45X40X40 |
| Turbocharger(dia) | 26.5 |
| Engine Coupling Box | 40X35X40 |
| Inlet Through Fins | 90X50 |
| Exhaust Pipe Diameter | 100 |
| Plank that is inserted | 110X60 |
| Coolant Temperature | 70 c |
| Diesel Temperature | 40 c |
| Load of Genset | 6.25 KVA |

## ANSYS GEOMETRIC MODELLING:

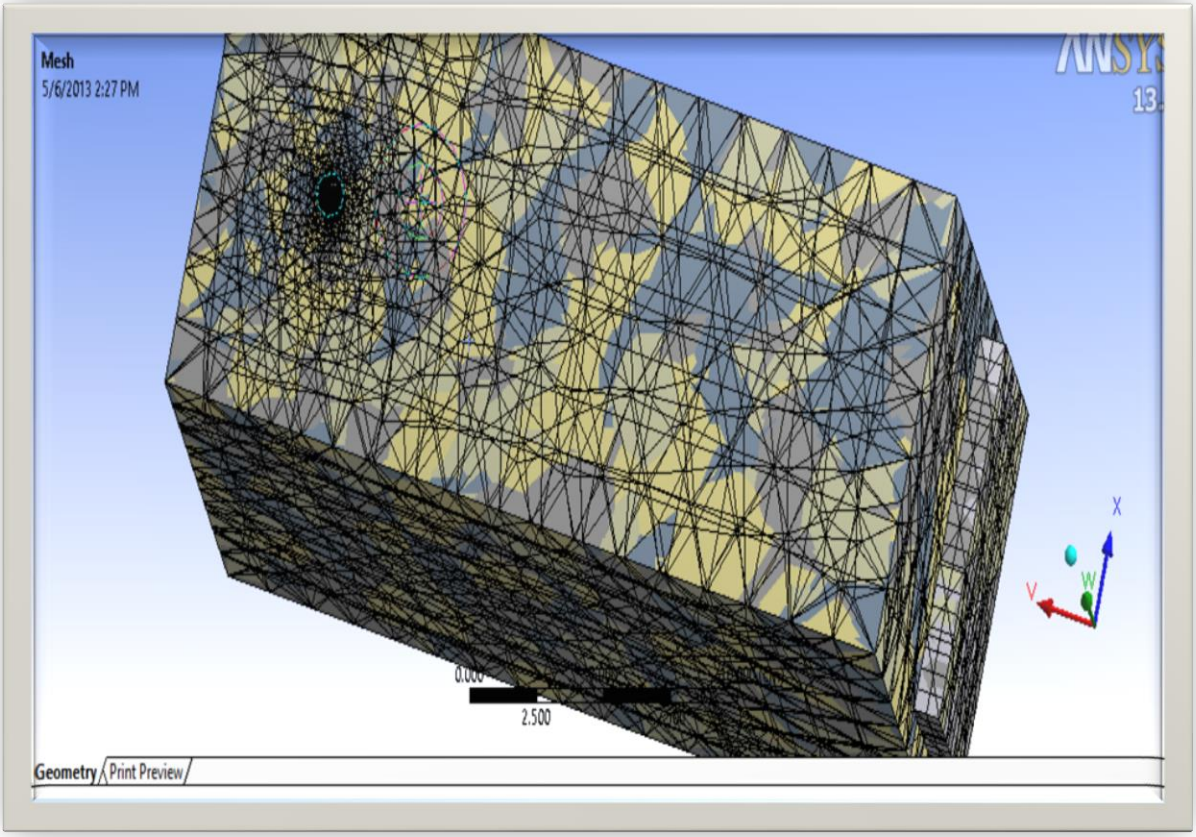
Usingupper dimensions a model is drawn in ANSYSV13.0 software.

This is shown in the following diagram:



# MESHING:

The above Geometric Model is taken and using the conditions such as the min face size 1.7066e-02 and max face size as 1.70660cm and after smooth meshing on all faces and volumes the generated surface mesh and volumetric mesh are as shown in the figure:



## Study of the temperatures inside the Generator-Set:

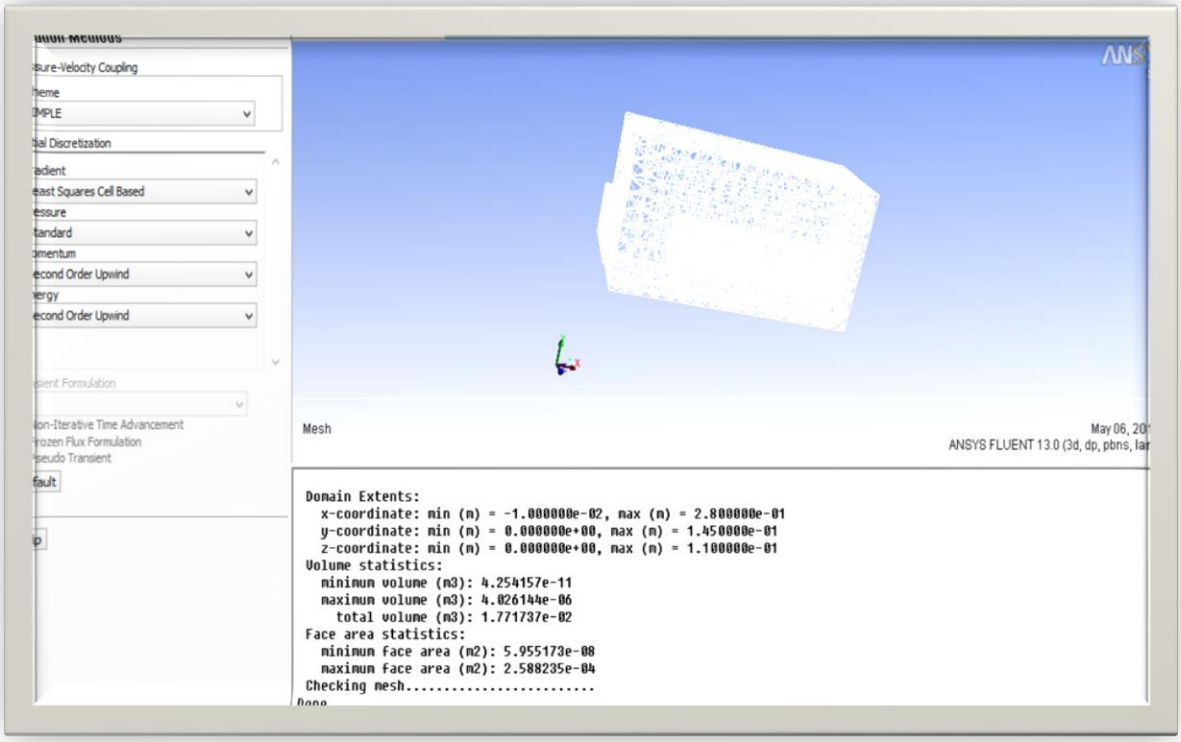
Using the leaf like thermo-couple with digital meter the following set of readings are calibrated :

| Surface | Temperature(c) |
|---|---|
| Generator Box | 37 |
| Power Box | 45 |
| Engine coupling | 58 |
| Engine | 80 |
| Exhaust Gas Temperature | 130 |
| Coolant Temperature | 70 |

Each face of different components taken into consideration are given the above temperature values and the velocity components , pressure components , temperature components inside the Generator-Box are calculated with the help of FLUENT ANSYS software.

## BOUNDARY CONDITIONS AND CELL-ZONE CONDITIONS :

The Meshed model is then imported into ANSYS FLUENT . Pressure based model is selected with absolute velocity formation And energy equation model is selected. The materials of different Components are entered and Fluid is taken to be Air. Boundary Conditions are specified as above stated from the study of temperatures. Solutions are initialized with second order Momentum and second order Energy equation.



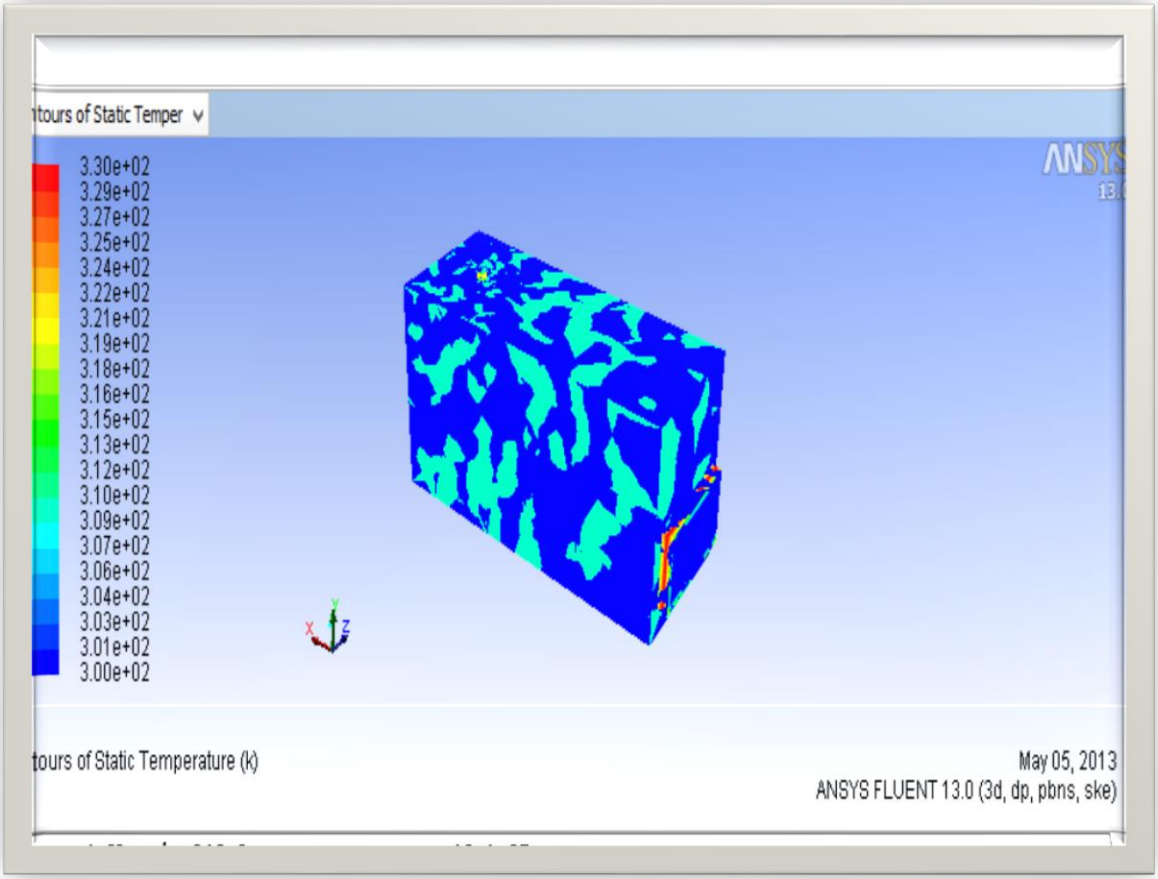
# CHAPTER 4

# Results and Discussion

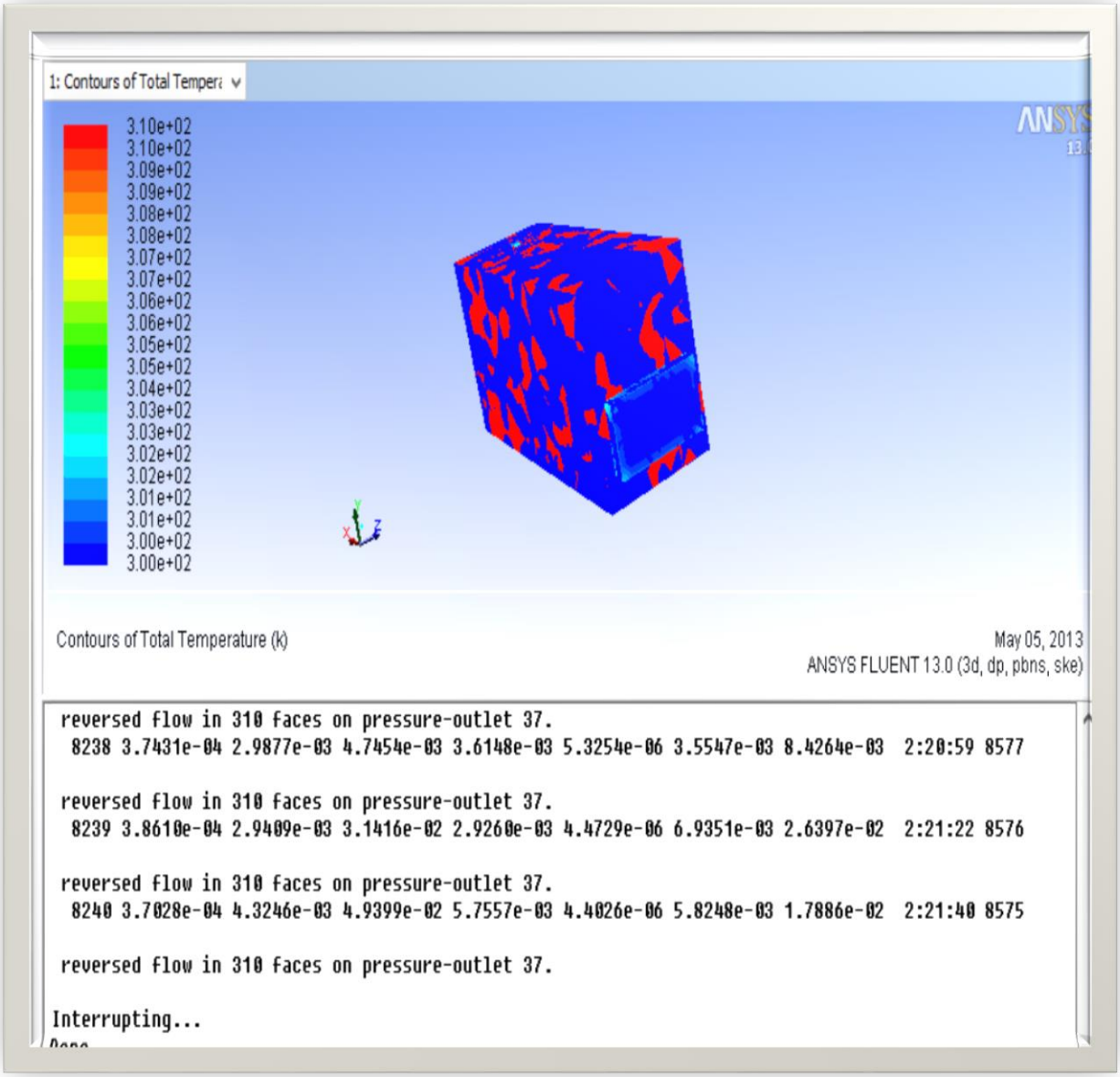
## Results and Discussion:

The following are the reults after 10,000 (or) more simulations

## CONTOURS OF STATIC TEMPERATURE:



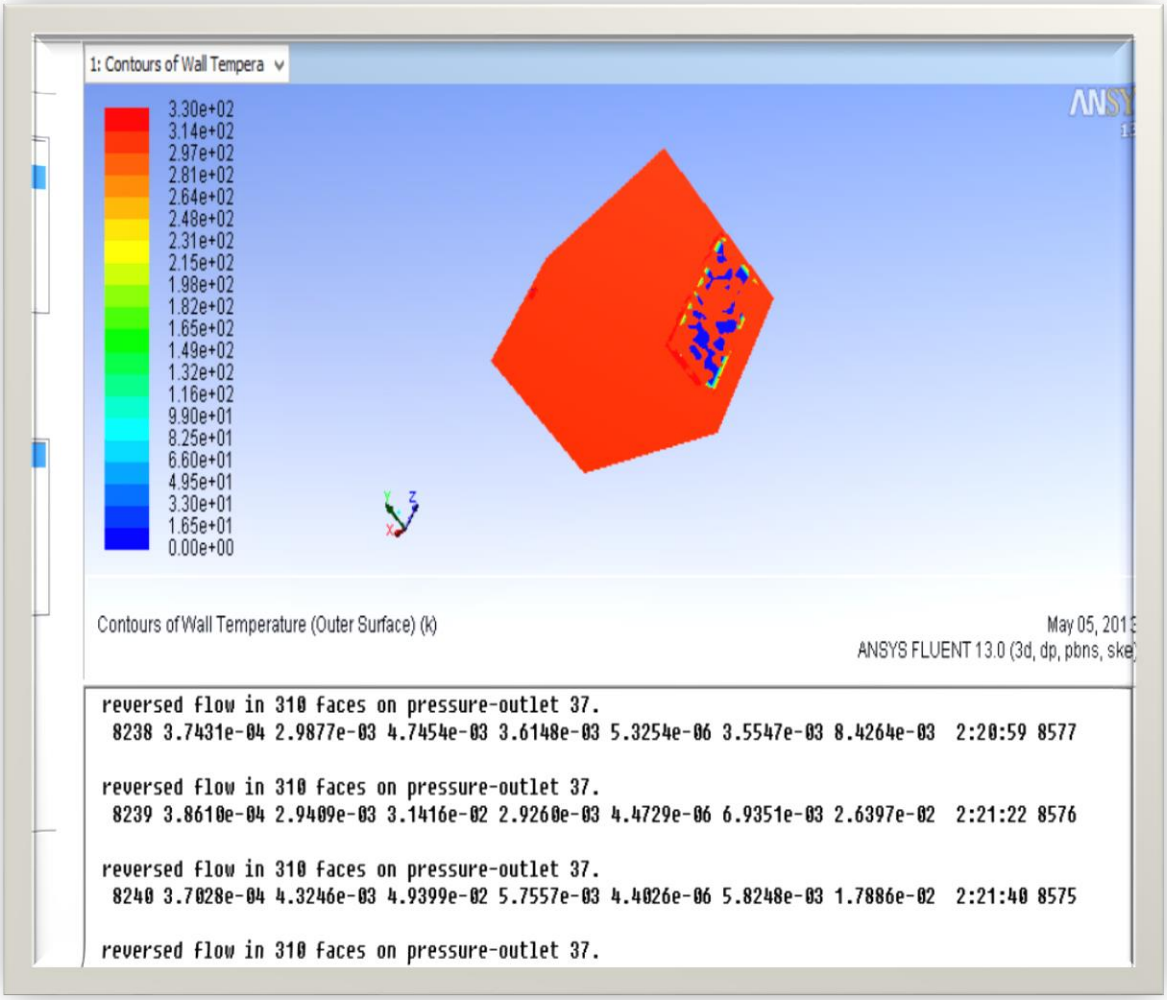
# CONTOURS OF TOTAL TEMPERATURE:




The regions and the temperature scale are shown above

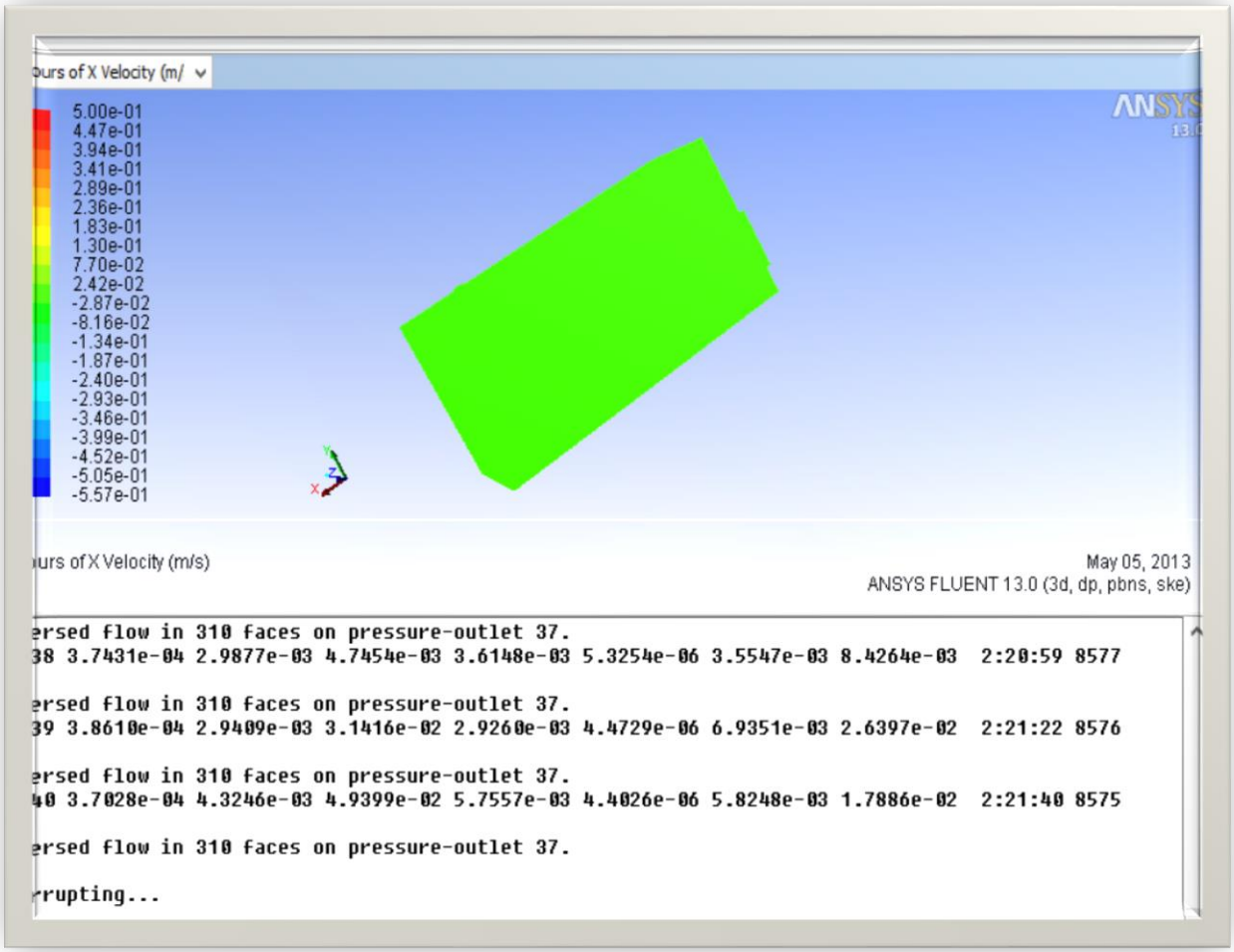
# CONTOURS OF WALL TEMPERATURE:

Contours of Outer Surface Wall Temperature are as follows:



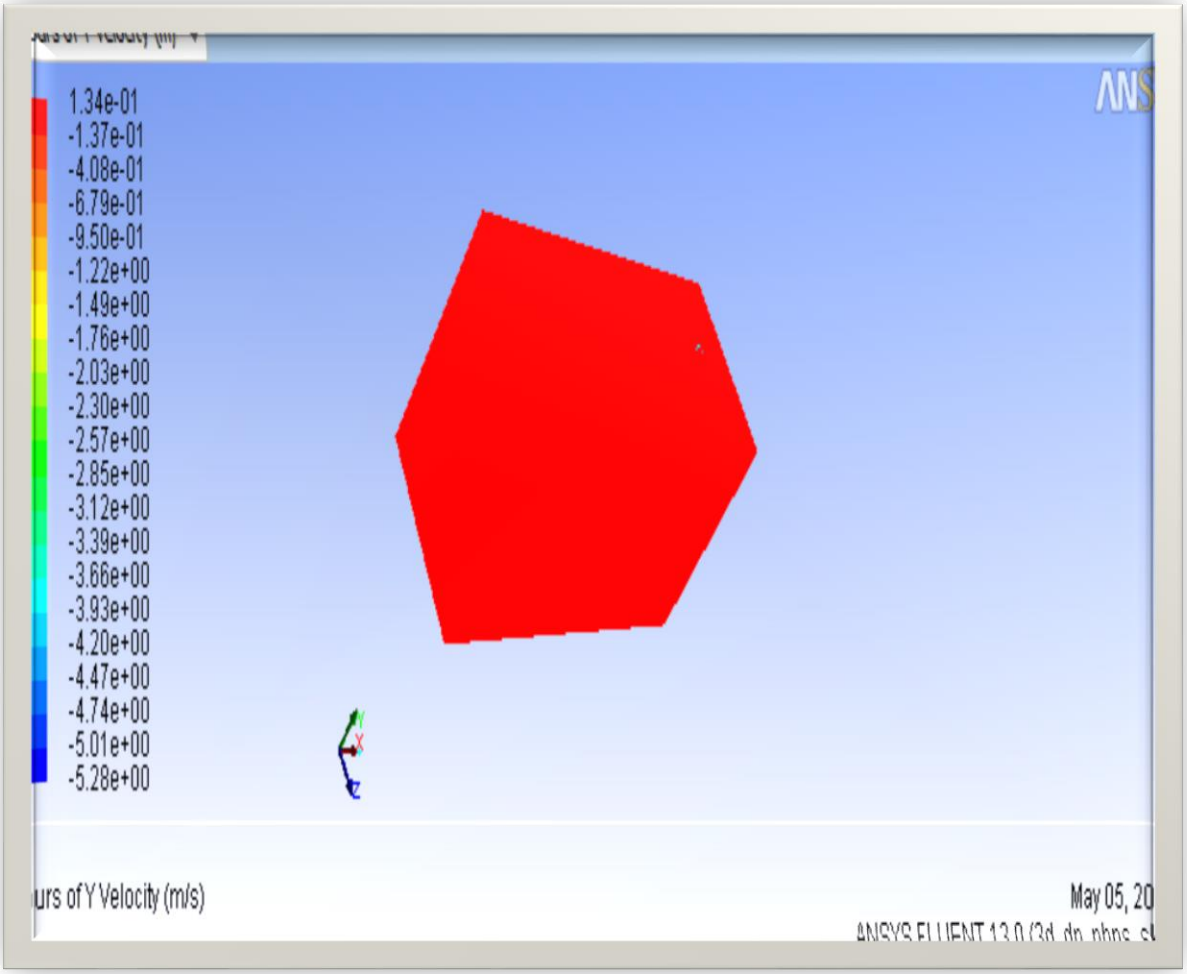
## CONTOURS OF X-Velocity:

Here are the contours of X-velocity for the total Gen-Set



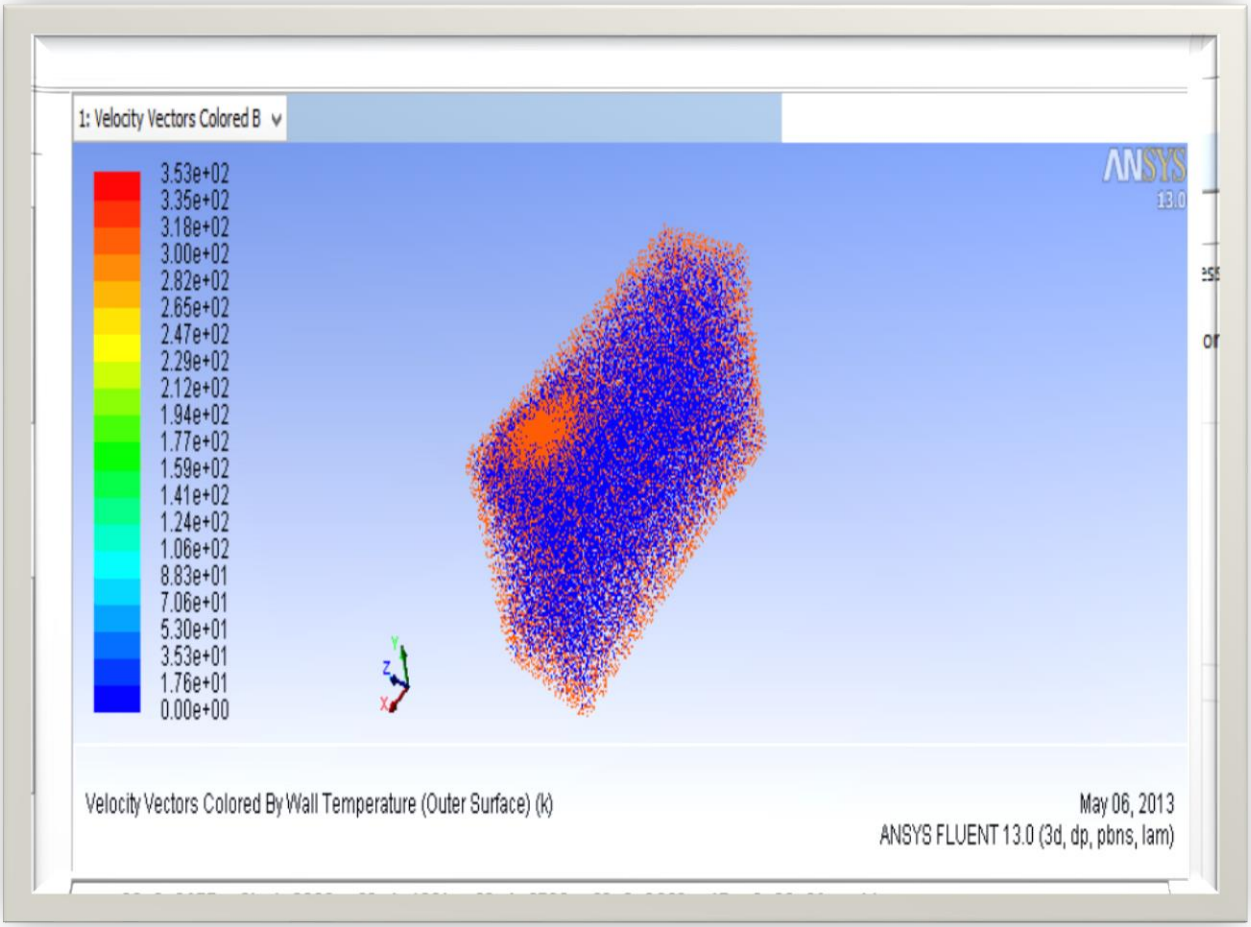
## CONTOURS OF Y –Velocity:

Contours of Y-Velocity and Velocity



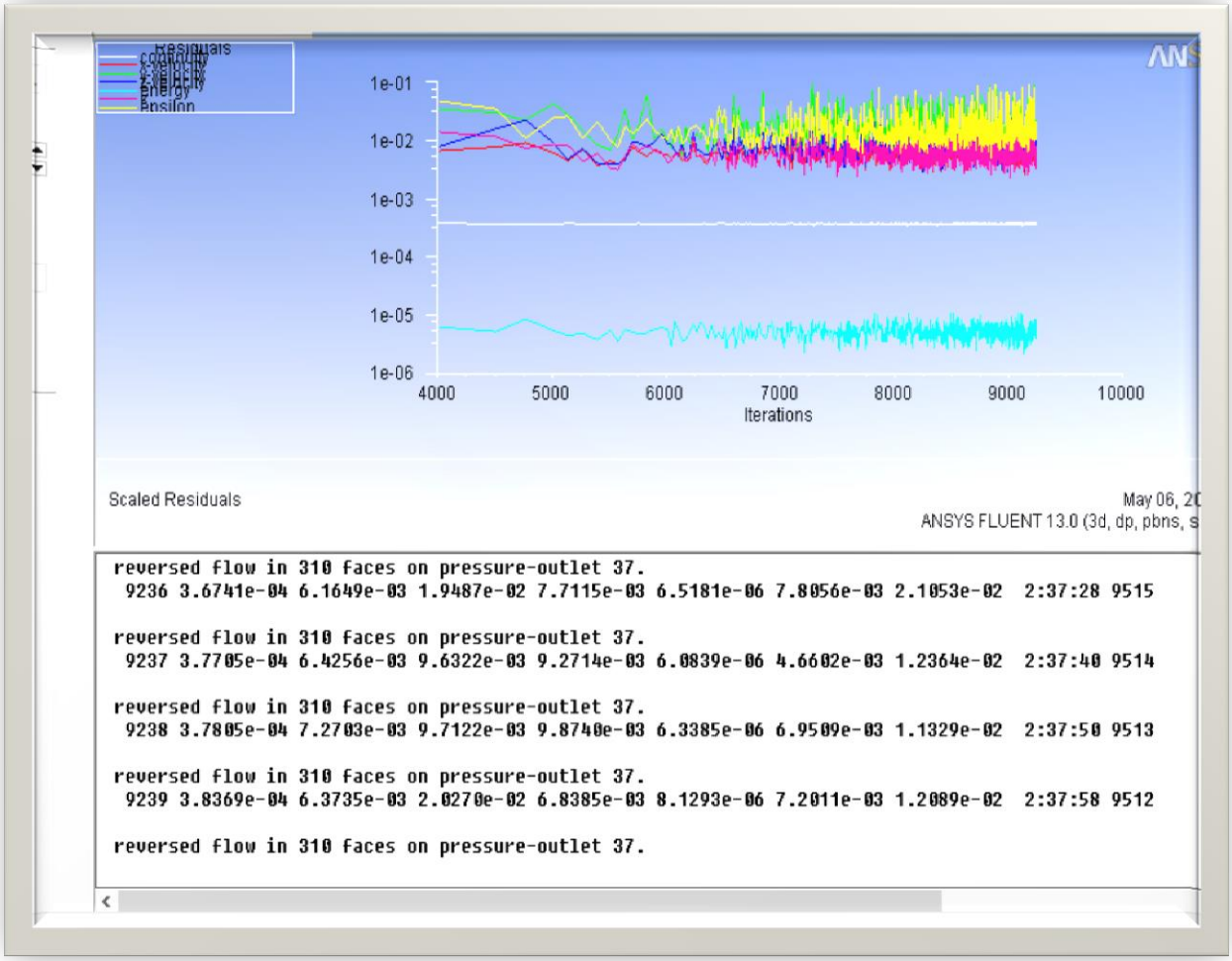
## CONTOURS OF Velocity Vectors coloured by Wall Temperatures:

Here are CONTOURS OF Velocity Vectors coloured by Wall Temperatures :



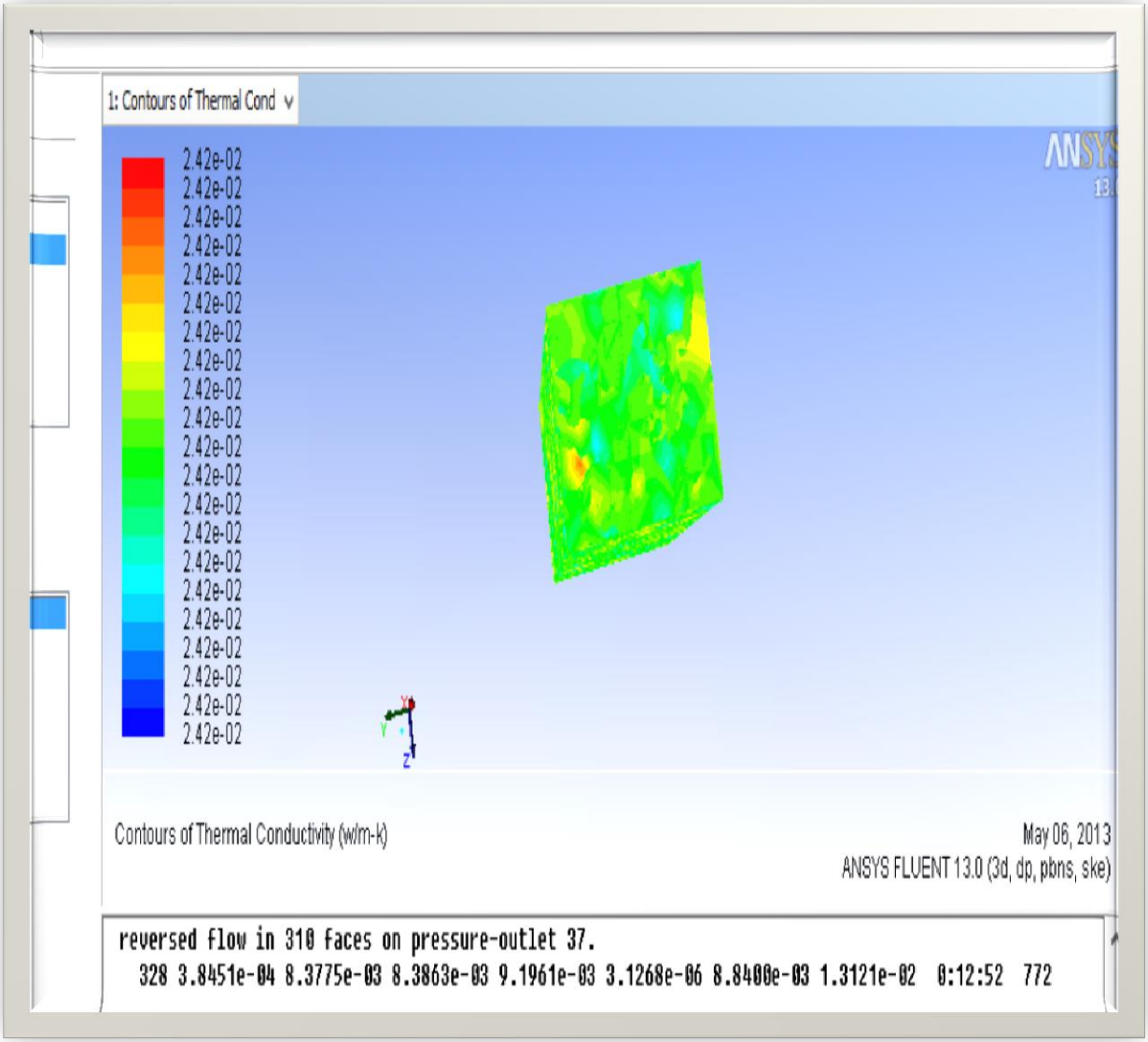
# X-Velocity Y-Velocity Z- Velocity Energy Epsilon :

Here are the scaled residuals



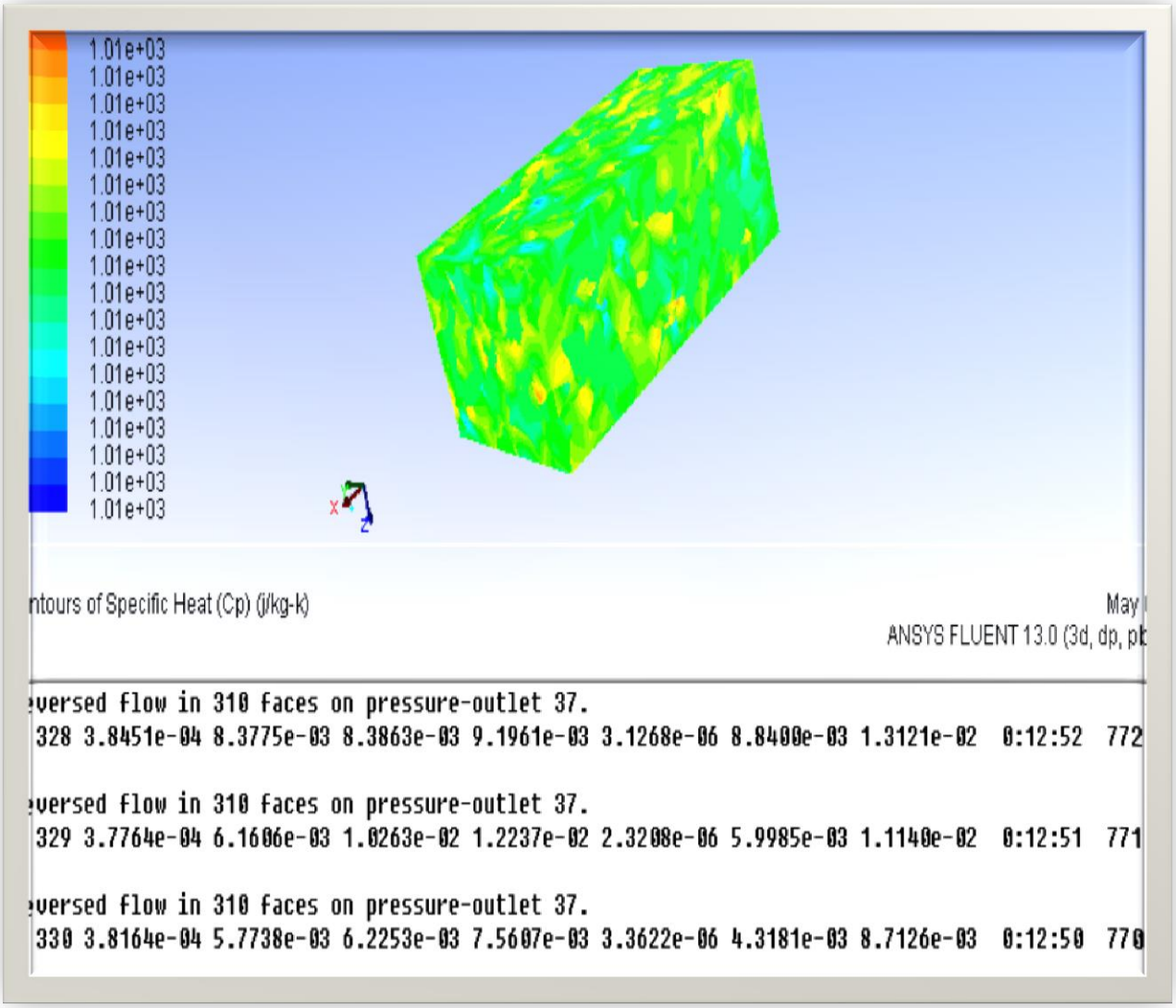
## CONTOURS OF THERMAL CONDUCTIVITY :

## Here are the contours of thermal conductivity



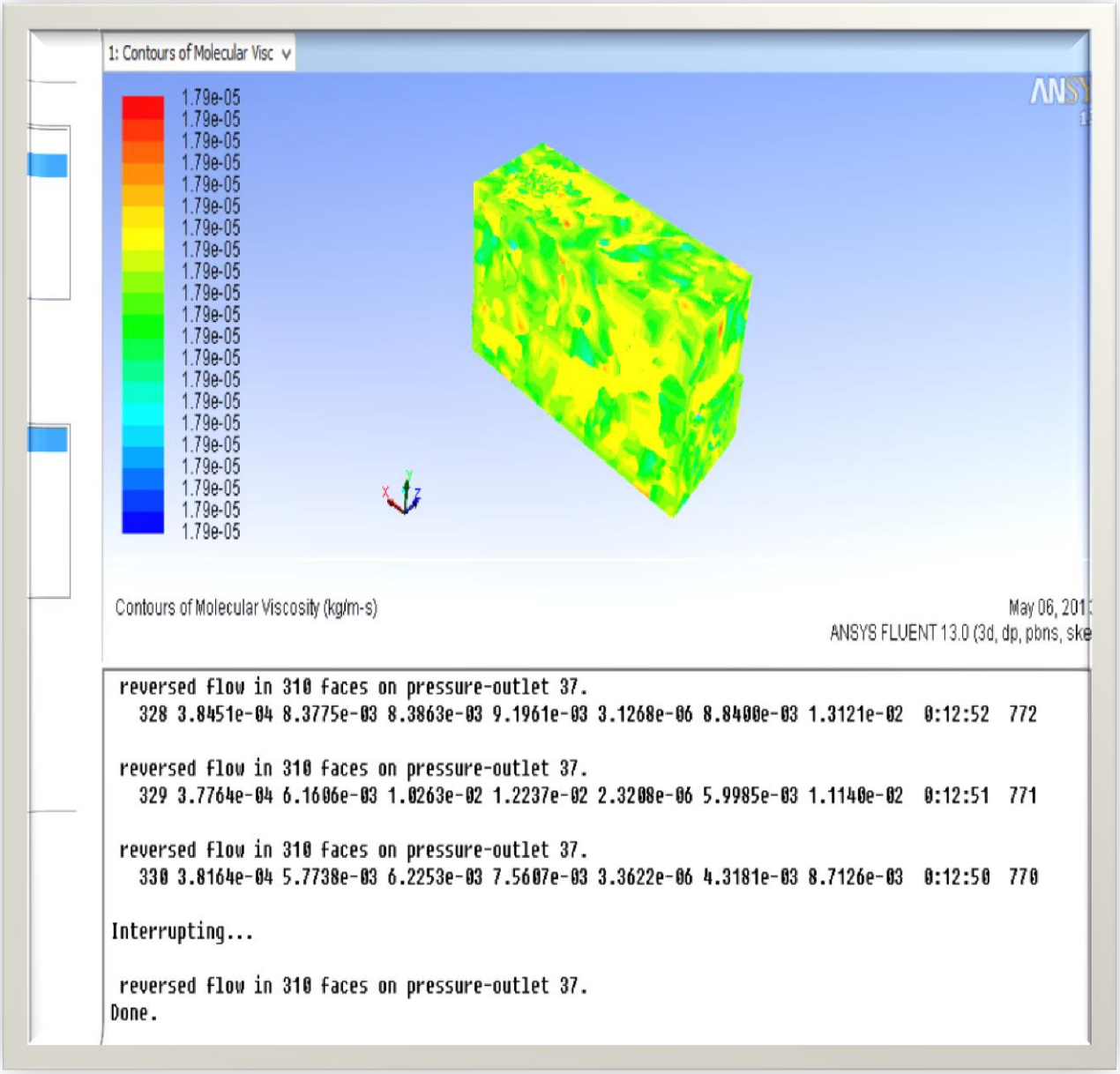
## CONTOURS OF SPECIFIC HEAT:

Here are the contours of Specific Heat:



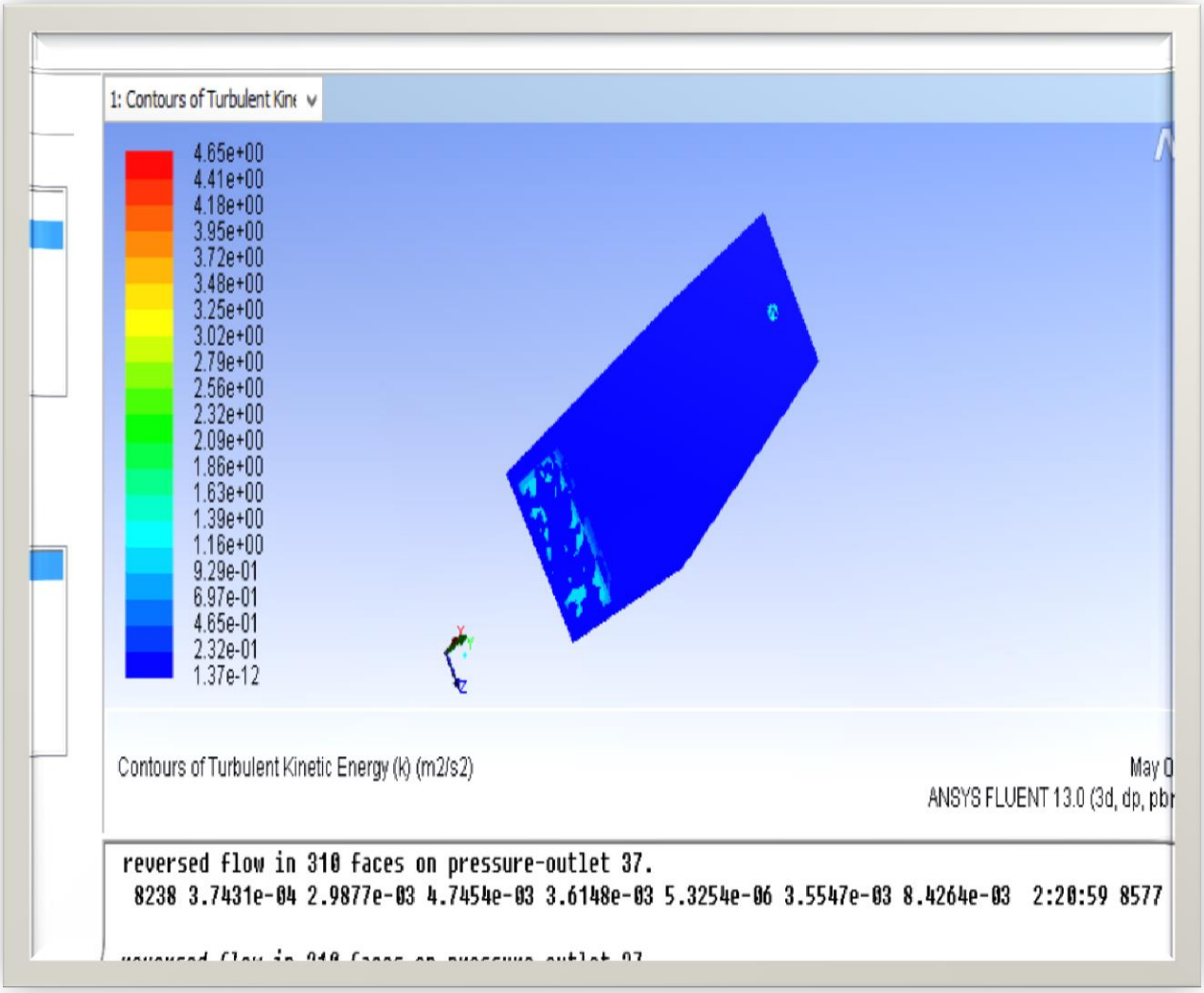
## CONTOURS OF MOLECULAR Velocity :

Here are the contours of Molecular-Velocity:



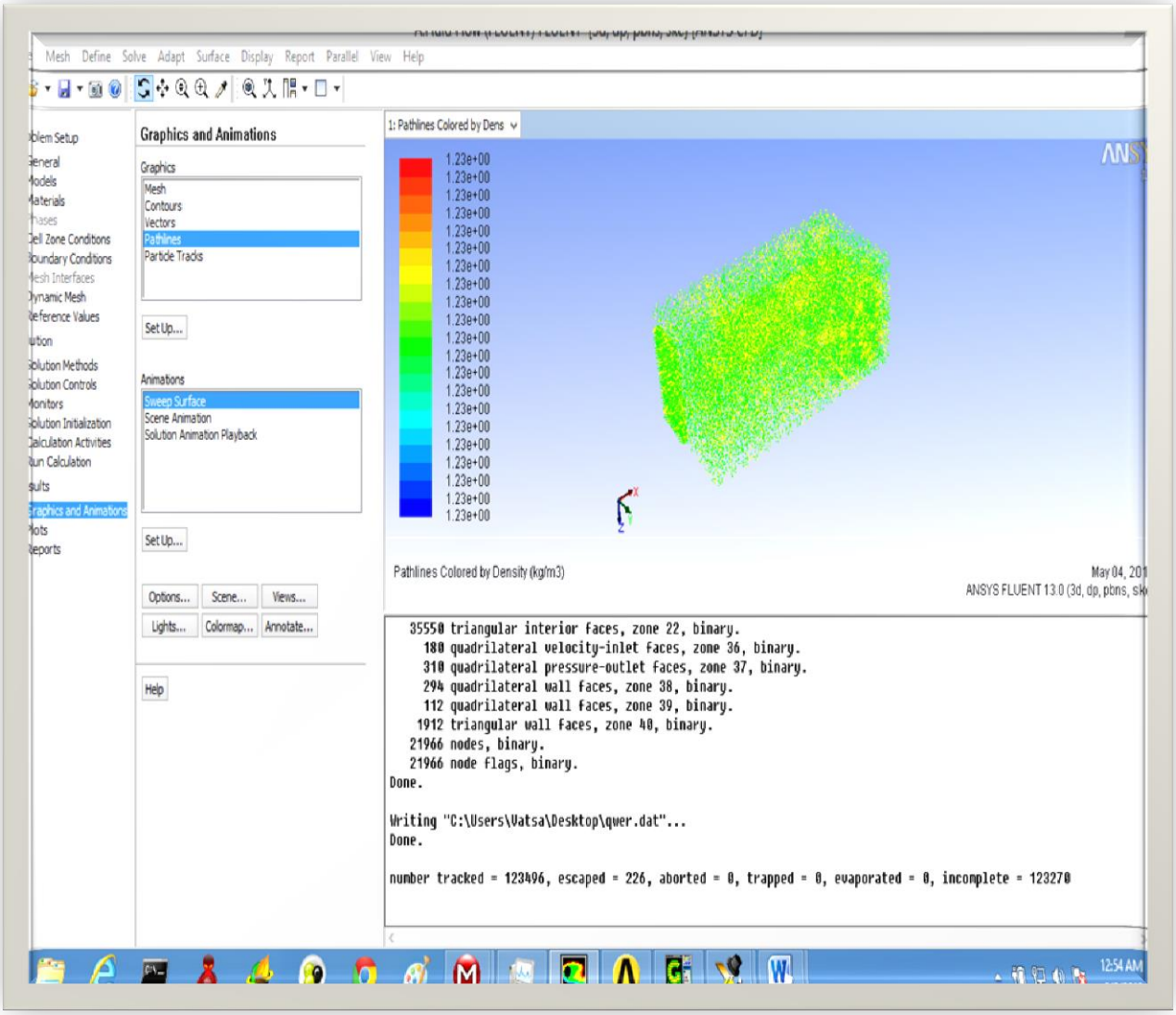
## CONTOURS OF TURBULENT KINETIC ENERGY:

Here are the contours of Turbulent Kinetic Energy:



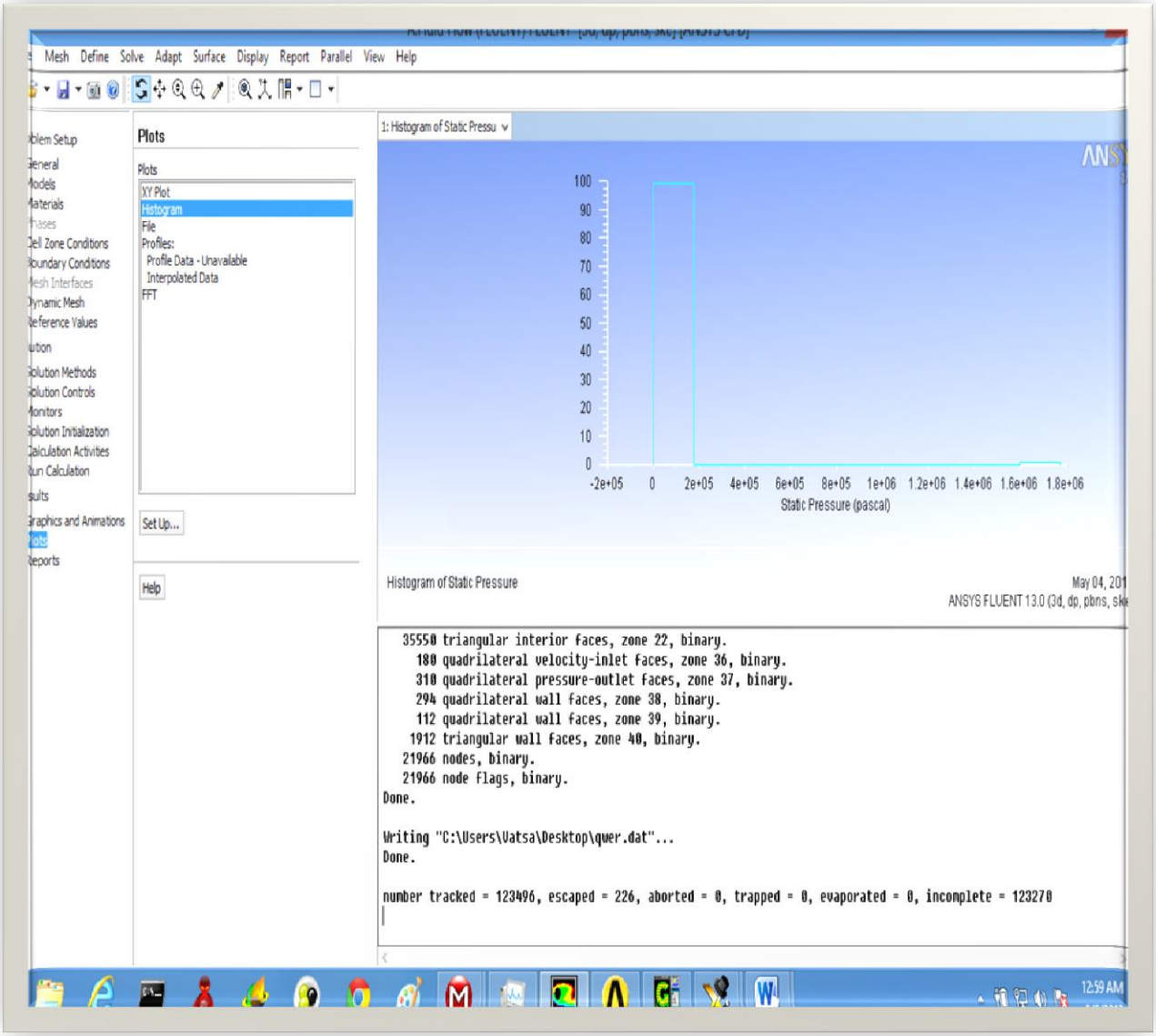
# **PathlinesColoured by Density**:

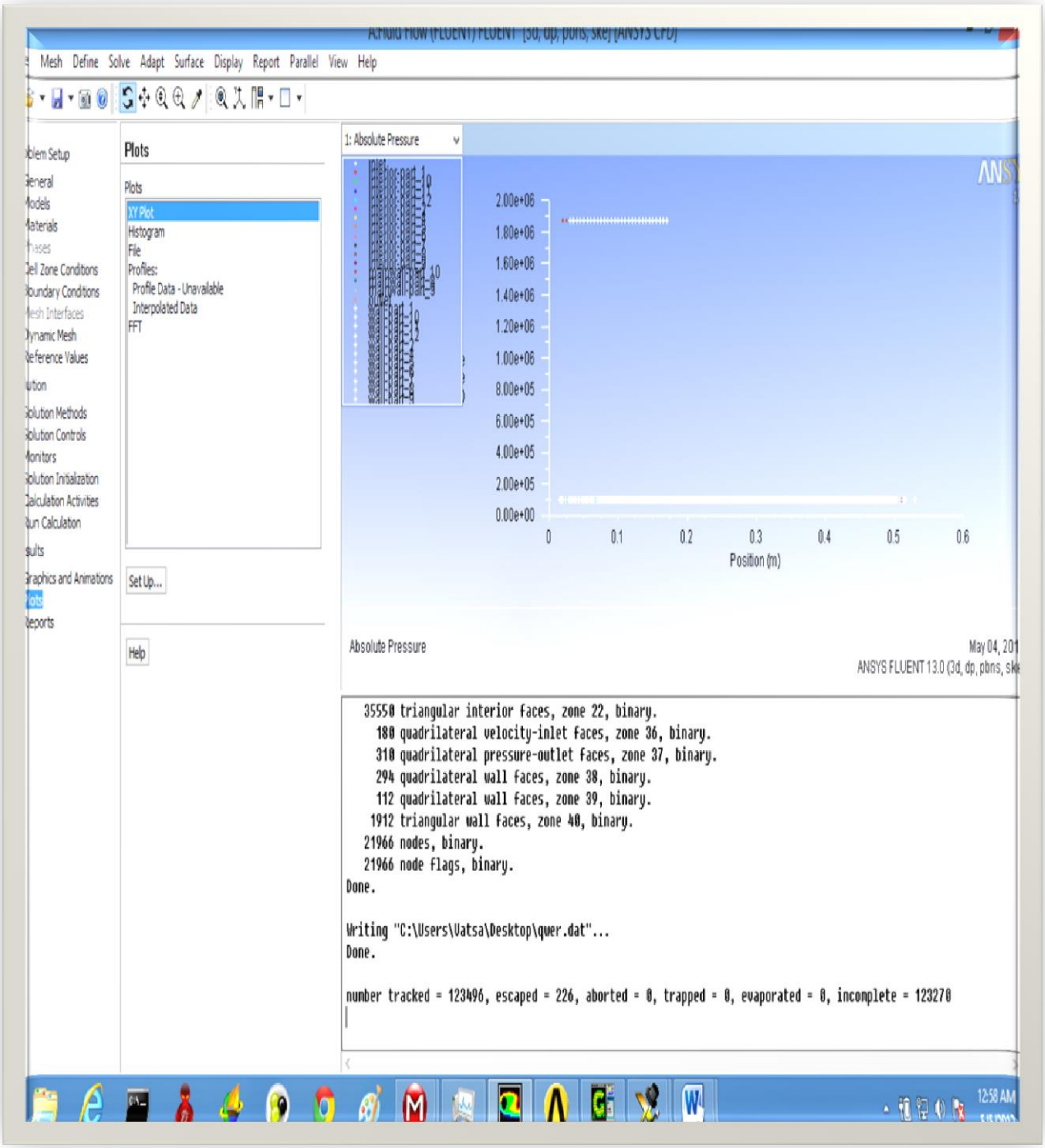
Contours  of density at defferent parts



# X-Y Plots and Histograms:

The below is a Histogram of Static Pressure :






The above is a X-Y Plot of Absolute pressure and Pressure

# CONCLUSIONS

- The exhaust gas velocity is obtained as 25.64 m/sec which is slightly less than the actual calculation 28.66m/ sec

- Engine should frequently run under high loads ; the engine running under low loads would result in the lesser life of the engine and the higher operating cost
- Thermal effeciencies of the generator would increase at high temperatures
- Coolant must be affective inorder not to increase the temperature of the diesel.
- The respective pressure contours and velocity contours are displayed.
- The temperature plots are calibrated by approximating the surface temperatures of the generator box and engine
- Running the engine under low loads would result in the low temperatures which would result in the low emissions of the engine

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